A new measure of equity and cash flow duration: The duration-based explanation of the value premium revisited

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Abstract

This paper re-examines the duration-based explanation of the value premium using novel estimates of the firms' equity and cash flow durations based on analyst forecasts. We show that the value premium can be explained by cross-sectional differences in the shares' equity durations, but not by their cash flow durations. Different from the duration-based explanation of the value premium that explains the value premium with cross-sectional differences in the firm's cash flow timing, we find that short-horizon stocks have lower (expected) returns than long-horizon stocks. This result is consistent with an upward-sloping equity yield curve.

JEL Classification: G12, G17

Keywords: equity duration, cash flow duration, value premium, analyst forecasts, B/M ratio, equity yields

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1. INTRODUCTION

The value premium, first detected by Graham and Dodd (1934), is one of the most prominent asset pricing puzzles: shares with a high book-to-market ratio of equity value (also called value stocks) provide on average higher returns than shares with a low book-to-market ratio (growth stocks). Most important, this additional return is not a compensation for the shares' higher systematic risk exposure as implied by the CAPM (Sharpe, 1964; Lintner, 1965), but seems to be a pricing anomaly with respect to this fundamental pricing model (Basu, 1983).

Recent advances in asset pricing theory suggest that cross-sectional differences in the firms' temporal cash flow pattern might play an important role in explaining the value premium. The influential duration-based explanation of the value premium (Lettau and Wachter, 2007, 2011) assumes that expected returns are decreasing in the timing of cash flows, i.e., the equity yield curve is downward-sloping. Under the premise that short-horizon equity exhibits high fundamental-to-price ratios (i.e., they are value stocks), a downward-sloping term structure of equity generates the value premium.[1]

This view does not go unchallenged. Prominent asset pricing models like the habit formation model (Campbell and Cochrane, 1999) or the long-run risk-model (Bansal and Yaron, 2004) imply an upward-sloping yield curve of equity, and hence a growth premium.[2] Besides, the empirical evidence by Binsbergen et al. (2013) suggests that the term structure of equity yields was only downward-sloping during the last two recessions.

This paper takes a new empirical perspective on the question whether differences in the firms' temporal cash flow pattern can explain the value premium. We put forward a simple and intuitive method to estimate the duration of individual shares. In analogy to bond duration, we derive duration from a share's price sensitivity to changes in the discount rate. To ensure that the duration estimates are entirely forward-looking, expectations of the firms' future cash flows are taken from equity analysts.

For each firm, we estimate two duration measures: equity duration and cash flow duration. *Equity duration* transfers the bond duration concept to equity shares as closely as possible. Similar to bond duration, equity duration is derived from a share's price sensitivity to changes in its proper actual (or implied) yield. Yet, equity duration is not an accurate measure of a firm's average cash flow timing, since the relative weight attributed to each cash flow depends on the firm's expected rate of return. Ceteris paribus, shares with high expected returns have by construction a shorter equity duration than shares with low expected returns. *Cash flow duration* circumvents this problem by applying an exogenous discount rate to all firms. It thereby isolates cross-sectional differences in the firms' cash flow patterns from such discount rate effects.

These novel duration measures allow to shed new light on the relation between the firms' durations, their B/M ratio – the traditional value/growth indicator – and stock returns. Analyzing a large sample of U.S. stocks from 1992 to 2010, we find that both duration measures are negatively related to the B/M ratio. As expected, value stocks have shorter equity and cash flow durations than growth stocks. Yet, the two duration measures differ significantly in their relation to stock returns. On the one hand, there is a positive relation between *cash flow duration* and (expected) stock returns. This result is consistent with an upward-sloping *equity yield curve* – companies that pay a large fraction of cash flows in the distant future provide higher returns, on average. In contrast, there is a strong negative relation between *equity duration* and (expected) stock returns, i.e., the *equity duration curve* is downward-sloping. This result shows that cross-sectional differences in expected returns have a significant effect on the firms' equity durations. Distant cash flows of companies with high expected returns are discounted at a high rate, such that their equity durations are rather short.

Since stocks with short equity durations have low B/M ratios and high (expected) returns, our results suggest that equity duration – and not cash flow duration – can explain the value premium. Additional tests confirm this hypothesis. Fama and MacBeth (1973) regressions show that the difference in returns between short and long equity duration stocks cannot be explained by shares' systematic risk exposure, suggesting that equity duration is a priced risk factor. Furthermore, an equity duration factor in the spirit of Fama and French (1993) is highly correlated with the value factor HML. Finally, a factor model that replaces the value factor with the equity duration factor generates lower pricing errors for the 25 ME/BE sorted equity portfolios.

The results of this study confirm conventional asset pricing theory. We substantiate the standard assumption in financial economics that growth firms are long-duration stocks, while value stocks are short-horizon equity. The positive relation between a firm's average cash flow timing and expected returns is consistent with standard consumption-based asset pricing models that imply an upward-sloping yield curve.

Different from Lettau and Wachter (2007), cross-sectional differences in the firms' cash flow timing alone cannot explain the value premium, as an upward-sloping equity yield curve implies a growth premium rather than a value premium. Instead, the study confirms the view that the value premium can be explained by the value firms' higher equity risk exposure not captured by the market beta. Since short-horizon value stocks are less exposed to discount rate risk, the value premium is a cash-flow risk premium. Hence, the B/M ratio can be conceived as a simple proxy for a more fundamental cash-flow risk factor. This finding is consistent with the asset pricing models by Da (2009) and Santos and Veronesi (2010), and empirical studies that document the importance of cash flow risk for the cross-section of stocks returns (Campbell and Voulteenaho, 2004; Da, 2009).

This paper builds on the recent empirical literature analyzing the duration-based explanation of the value premium. Empirical tests boil down to analysing (1) the relation between the B/M ratio, the traditional value/growth indicator, and the duration of equities and (2) the term structure of expected equity returns.

Dechow et al. (2004) are the first to estimate an equity duration for individual shares by relating market prices to expected cash flows. They predict future cash flows by applying an autoregressive process of firm profitability on current fundamentals.[3] Da (2009) estimates an ex-post cash flow duration of equity portfolios by discounting actual dividend payments at some exogenously specified discount rate. Similar in spirit, Chen (2014) measures the ex-post growth rates of value and growth portfolios. While Dechow et al. (2004) and Da (2009) find that value stocks have shorter equity or cash flow durations than growth stocks, the result of Chen (2014) suggest that there are only minor differences in the firms' growth rates, and hence cash flow durations.

Our paper is different from these works in several important aspects. By deriving duration from a share's price sensitivity to changes in the discount rate we are – to our knowledge – the first to estimate both equity and cash flow durations for a large cross-section of individual shares. This allows to draw direct comparisons between these two measures of a firm's average cash flow timing. In contrast to Da (2009), we derive an ex-ante duration measure, which is not only observable ex-post. Since share prices reflect expectations about future cash flows, this approach is conceptually more consistent.

Using equity analyst forecasts as proxy for expected cash flows ensures that duration estimates are entirely forward-looking, and not building on the premise that past information conveys information about the future. The underlying assumption of using analysts' cash flows forecasts to estimate a share's duration is that these forecasts accurately reflect the investors' true expectations about future cash flows. Deviations from this assumption, caused by, e.g., biased forecasts could distort the results. Several robustness checks show that the relation between the firm's duration and stock returns is unlikely to be driven by such biases. Our main results remain unchanged when using autoregressive earnings forecasting models instead of analyst forecasts. Furthermore, our analyst-based equity duration estimates are better in explaining the cross-section of stock returns than the equity duration measure by Dechow et al. (2004).

The second component of the duration-based explanation of the value premium, the downward-sloping term structure of equity yields, is difficult to estimate since zero-coupon equities or dividend strips for individual companies are not traded. Binsbergen et al. (2012) circumvent this problem by using option data to synthetically derive prices of dividend strips for the aggregate market. They present evidence that the market equity yield curve is indeed downward sloping. Using duration as a measure of cash flow timing, Dechow et al. (2004) and Da (2009) also find a negative relation between cash flow timing and stock returns.

Yet, Boguth et al. (2013) show that the approach chosen by Binsbergen et al. (2012) might overstate their results. Using a more robust analysis, they show that the slope of the term structure of equity yields is less downward sloping than originally thought. In fact, using novel market equity dividend strip data, Binsbergen et al. (2013) show that the term structure of equity yields was only downward-sloping during the last two recessions.

By showing that expected returns are – on average – increasing in the shares' expected cash flow timing, we also contribute to this stream of literature. In fact, additional tests suggest that the term structure of equity yields is time-varying, and that its slope can even flip sign. In light of this, our finding is not necessarily contradicting previous empirical studies, but rather highlighting that more research needs to be done to better understand the dynamics equity yield curve.

The importance of cash flow risk for the cross-section of stock returns has only been recognized recently. Following the CAPM, expected stock returns are proportional to their beta with the market portfolio, i.e., the covariance between stock returns and market returns. Given that returns can be driven by news about expected cash flows and news about discount rates, a series of papers analyses the determinants of market betas.[4] These studies find that value stocks have larger cash flow betas than growth stocks, and that cross-sectional differences in cash flow betas are primarily due to variations in the firms' cash flows. For example, using an ICAPM à la Merton (1973), Campbell and Voulteenaho (2004) show that cash flow betas carry higher risk premia than discount rate betas, which explains the value premium. Other recent studies also highlight the importance of cash flow risk for stock returns. Koijen et al. (2015) show that value stocks experience much larger negative cash flow shocks in economic downturns than growth stocks. Chen et al. (2013) show that stock returns are significantly driven by cash flow news.

The paper develops as follows. The next section presents the duration-based explanation of the value premium in more detail. Section 3 introduces the concepts of equity and cash flow duration, and presents the estimation approach. Section 4 contains a brief description of the U.S. data sample. Section 5 analyzes the relation between equity duration, cash flow duration and firm risk. In section 6, we examine the relation between the firms' cash flow maturity and the cross-section of stock returns. Additional robustness test are presented in section 7. We discuss our results in section 8, while section 9 offers some concluding remarks.

2. THE DURATION-BASED EXPLANATION OF THE VALUE PREMIUM

The duration-based explanation of the value premium by Lettau and Wachter (2007) explains the cross-section of stock returns by cross-sectional differences in the firms' cash flow timing, i.e., their cash flow duration. Firms are modelled as zero-coupon equities, similar to zero-coupon bonds. All firms have identical cash flow risks, but differ in the timing of cash flows. Shocks to discount rates are not priced in the economy, and are uncorrelated with shocks to both expected and unexpected cash flows. Furthermore, shocks to expected and unexpected cash flows are negatively related. The model generates a downward-sloping term structure of equity, i.e., short duration stocks have higher expected returns than long-horizon equity. In addition, the model implies that short-term assets have lower price-to-cash-flow ratios, i.e., they are value stocks. Taken together, these two features explain the value premium.

The intuition of the model, see also Santos and Veronesi (2010) and Binsbergen et al. (2012), is as follows. Risk-averse investors care about maintaining a smooth consumption profile. Consumption is mostly financed by the front-loaded dividends of value stocks rather than by growth stocks. Yet, because of their substantial dividends, value stocks are more exposed to aggregate cash flow shocks. Hence, they are perceived more risky, sell at a discount, and provide higher returns. Growth stocks are less risky since a negative cash flow shock is partly offset by higher expected cash flows in the future. Accordingly, the value premium is a compensation for the value firms' risky cash flow timing. In an extension, Lettau and Wachter (2011) show how to modify their model to fit the term structure of interest rates as well.

Standard habit formation models à la Campbell and Cochrane (1999) and Menzly et al. (2004) with counter-cyclical risk premia rather produce a growth premium instead of a value premium. Similarly, the popular long-run risk model by Bansal and Yaron (2004) generates an upward-sloping term structure of equity as well, as Binsbergen et al. (2012) show. In fact, Santos and Veronesi (2010) and Da (2009) show that not a firm's temporal cash flow pattern alone, but its cash flow risk or cash flow covariance with consumption is crucial to explain the observed cross-section of stock returns, and the value effect in particular. This view is also supported by Brennan and Xia (2006). Using an ICAPM with the real rate, expected inflation, and the Sharpe ratio as state variables, they show that a share's risk premium is not unambiguously decreasing with its cash flow maturity. By exogenously specifying an stochastic discount factor that fits the data, Lettau and Wachter (2007) avoid modelling preferences that are in line with their assumptions.

In order to reconcile these conflicting views, the literature has proposed several modifications to the above models in order to generate a downward-sloping term structure of equity. Croce et al. (2015) introduce a learning component to the long-run risk model of Bansal and Yaron (2004). If the agents of the economy cannot distinguish between short-term and long-term shocks, risk premia on short-horizon equities can be higher than on long-term equity. Ai et al. (2015) add a vintage capital model to the Bansal and Yaron (2004) model, which generates a downward-sloping equity yield curve for the short horizon. Belo et al. (2015) modify the dividend dynamics of Campbell and Cochrane (1999) and Bansal and Yaron (2004), which also produces a downward-sloping term structure of equity.

3. EQUITY AND CASH FLOW DURATION

Equity and cash flow duration transfer the bond duration concept to equities. This section first defines equity and cash flow duration. Then we introduce a novel approach to estimate both duration measures for individual shares.

3.1. Equity duration

Equity duration is defined, in analogy to bond duration (Macaulay, 1938), as the discounted cash flow weighted average time at which shareholders receive the cash flows from the investment in a company's share. In the spirit of Leibowitz et al. (1989), we use the following definition in continuous time:

DEFINITION 1 (Equity duration): *Let P_0 denote the share price at time $t = 0$, $E_0[c_t]$ the expected stream of cash flows per share at time t, and k the share's implied equity yield. Then equity duration D_0^{EQ} is defined as*

$$D_0^{EQ} = \frac{1}{P_0}\int_{t=0}^{\infty} t\, E_0[c_t]e^{-kt}dt. \tag{1}$$

The implied equity yield k, also called implied cost of capital (ICC), is the internal rate of return that equates share price to discounted expected cash flows, similar to a bond's yield to maturity. In analogy to bond yield, the implied equity yield measures a share's expected rate of return or, equivalently, the firm's cost of equity capital.[5]

Equity duration differs from bond duration in two aspects. First, equity investments do not have a predetermined maturity date, but are a claim to a potentially infinite stream of cash flows. Second, since cash flows to shareholders are uncertain, equity duration can only be defined for expected cash flows.

Leibowitz et al. (1989) show that equity duration can also be derived from a share's price sensitivity to changes in expected returns. Start from the present value formula for a share

$$P_0 = \int_{t=0}^{\infty} E_0[c_t]e^{-kt}dt. \tag{2}$$

Then establish a relation between (1) and (2) by

$$\frac{\partial \ln P_0(k)}{\partial k} = \frac{1}{P_0}\frac{\partial P_0(k)}{\partial k} = -\frac{1}{P_0}\int_{t=0}^{T} tE_0[c_t]e^{-kt}dt = -D_0^{EQ}$$

to obtain the following expression:

DEFINITION 2 (Equity duration as share price sensitivity): *Take a pricing function of a share $P_0(k)$, where k is the share's expected rate of return. Then equity duration D_0^{EQ} is given as*

$$D_0^{EQ} = -\frac{1}{P_0}\frac{\partial P_0(k)}{\partial k}\,. \tag{3}$$

Similar to bonds, shares with a long equity duration are more sensitive to changes in expected returns than shares with a short duration. Equity duration hence measures a share's discount rate risk.[6]

EXAMPLE 1 (Gordon (1962) growth model): *Suppose cash flows grow at a constant rate g forever. Then the pricing function* (2) *can be simplified to*

$$P_0 = \frac{c_0}{k - g}\,, \tag{4}$$

where c_0 denotes the rate of cash flows at $t = 0$. Using (3)*, we obtain*

$$D_0^{EQ} = -\frac{1}{P_0}\frac{\partial P_0}{\partial k} = \frac{1}{k - g}\,. \tag{5}$$

In this example, equity duration depends on two parameters only, a firm's cash flow growth rate and the expected rate of return. Companies with a high cash flow growth have a long equity duration since a large fraction of cash flows occurs in the far future. This component of equity duration captures the firm's cash flow timing.[7] In addition, equation (5) shows that companies with low expected returns have a long equity duration because the weight attributed to distant cash flows is greater. Since expected returns reflect a firm's risk exposure, this constituent of equity duration measures the firm's cash flow risk. Taken together, equity duration thus depends on two different factors, cash flow timing and cash flow risk. Solving the Gordon (1962) model for the expected return, we have

$$k = \frac{c_0}{P_0} + g.$$

Insert this expression into the duration formula (5) and expand to obtain

$$D_0^{EQ} = \frac{P_0}{c_0} = \frac{P_0}{e_0}\frac{1}{p} = \frac{P_0}{b_0}\frac{1}{p \cdot roe}\,, \tag{6}$$

where p and roe denote payout ratio and return on equity in the steady state, e_0 are earnings, and b_0 is the book value of equity. Expression (6) establishes a connection between equity duration and different price-to-fundamental ratios. When equating cash flows with dividends, equity duration equals the price-to-dividend ratio (Lintner, 1971). The lower the dividend yield, the longer it takes for an investor to recoup the equity investment. When expressing dividends as the fraction of earnings paid to shareholders, equity duration is proportional to the price-to-earnings ratio (Dechow et al., 2004). Since earnings are not subject to payout policies, the P/E ratio might be a more reliable empirical proxy for equity duration. The above equation also establishes a link between equity duration and the Fama-French value indicator B/M ratio. Stocks with a high B/M ratio (i.e., value stocks) are short-duration stocks, and growth stocks are long-duration stocks. Hence, in a Gordon (1962) setting, price-to-dividend, price-to-earnings and book-to-market ratios are alternative expressions for a share's equity duration.

Combining expressions (5) and (6) shows that the B/M ratio equally depends both on a firm's cash flow growth and expected rate of return,

$$\frac{b_0}{P_0} = \frac{k - g}{p \cdot roe}. \tag{7}$$

Not only companies with high cash flow growth rates are "growth stocks", but also those with a low cost of capital, see also Cohen et al. (2003). Equation (7) implies that higher returns for value stocks are a compensation for either the value firms' low cash flow growth rates or their higher equity risk, or both.

3.2. Cash flow duration

Using equity duration to measure a share's cash flow maturity has intuitive appeal since it matches the well-established concept of bond duration. However, equity duration is not an accurate measure of a firm's cash flow timing, since it also depends on the firm's equity risk (Hansen et al., 2008). Yet, the duration-based explanation of the value premium by Lettau and Wachter (2007) defines equity shares as zero-coupon equity that differ only in their cash-flow timing. We therefore follow Da (2009) and estimate a share's temporal cash flow profile by the firm's cash flow duration. In analogy to equity duration, we use the following definition:

DEFINITION 3 (Cash flow duration): *Let $E_0[c_t]$ denote the expected stream of cash flows per share at time t, and $\overline{k}$ an exogenous discount rate for all firms. Then cash flow duration D_0^{CF} is defined as*

$$D_0^{CF} = \frac{1}{\overline{P}_0} \int_{t=0}^{\infty} t\, E_0[c_t] e^{-\overline{k}t} dt, \tag{8}$$

where

$$\overline{P}_0 = \int_{t=0}^{\infty} E_0[c_t] e^{-\overline{k}t} dt.$$

Different from equity duration, cash flow duration does not use price information. Instead of relying on the firm's implied equity yield, expected cash flows are discounted at an identical, exogenously specified discount rate across all firms. Cash flow duration can hence be interpreted as equity duration with exogenous discount rate.

EXAMPLE 1 *continued: In the Gordon (1962) model, cash flow duration is given by*

$$D_0^{CF} = \frac{1}{\bar{k} - g}.$$

Similar to equity duration, cash flow duration depends on the firm's cash flow growth rate. Companies with a high cash flow growth have a long cash flow duration. However, by using an exogenously specified discount rate, cash flow duration does not depend on the firm's equity risk, and therefore isolates cross-sectional differences in the firms' temporal cash flow pattern from the heterogeneity in expected returns. Cash flow duration hence allows for an accurate assessment of cross-sectional differences in the firm's cash flow timing.

In analogy to cash flow duration, it is possible to define another duration measure that applies a constant, exogenous cash flow growth rate to all firms to isolate cross-sectional differences in expected returns from the firms' heterogeneity in cash flow growth. We present such an analysis in the online appendix A. Using both constraint duration measures, this appendix shows that the main determinant of the cross-sectional variation in equity duration is cross-sectional differences in expected returns rather than expected cash flow growth rates.

3.3. Estimation

Given the uncertainty about expected cash flows until infinity, a share's duration is more difficult to estimate than bond duration. In this paper we use a discrete-time approximation of definition 2 to estimate equity and cash flow duration. In discrete time, the derivative of the present value formula (2) with respect to the expected return is given by

$$\frac{\partial P_0}{\partial k} = -\frac{1}{1+k}\sum_{t=1}^{\infty} t\frac{E_0[c_t]}{(1+k)^t} = -\frac{P_0}{1+k}D_0,$$

such that duration can be approximated by

$$D_0 \approx -\frac{\Delta P_0}{\Delta k}\frac{1+k}{P_0}\,. \tag{9}$$

A share's duration hence equals the slope of a share's pricing formula with respect to the discount rate, standardized by the factor $-(1+k)/P_0$. Given the well-known shortcomings of the Gordon (1962) model, we follow the literature on the implied cost of capital and use a more complex residual income model (RIM) as pricing formula (Edwards and Bell, 1961). This model states that the value of a company equals its invested equity capital, plus the expected discounted residual income from future activities.

DEFINITION 4 (Residual income model): *Let b_t denote the book value of equity per share at the end of year t, e_t the earnings per share in year t, and k the cost of equity capital. Then the residual income per share ri_t is defined as:*

$$ri_t = e_t - k(b_{t-1}). \tag{10}$$

If $E_0[ri_t]$ denotes the expected residual income per share in year t, the price of a share P_0 is

$$P_0 = b_0 + \sum_{t=1}^{\infty}\frac{E_0[ri_t]}{(1+k)^t}. \tag{11}$$

We use equity analyst earnings forecasts as proxy for the firms' expected cash flows. Consistent with prior research (Griffin, 1976; Elton et al., 1981; Park and Stice, 2000) we assume that these forecasts are a good proxy for the marginal investor's expectations.[8] Since earnings forecasts are not available until infinity, one has to make assumptions about expected cash flows in the long run when implementing the model in practice. This paper resorts to the two-stage approximation by Claus and Thomas (2001), which has shown to be the best model to estimate expected returns (Easton and Monahan, 2005).[9]

DEFINITION 5 (Two-stage residual income valuation): *Let $E_0[e_t]$ denote the expected earnings per share. Then the price of a share is given by*

$$P_0 = b_0 + \underbrace{\sum_{t=1}^{5} \frac{E_0[e_t] - k(b_{t-1})}{(1+k)^t}}_{\textit{growth period}} + \underbrace{\frac{E_0[ri_5](1+g^l)}{(k-g^l)(1+k)^5}}_{\textit{stable growth}} . \tag{12}$$

The model combines earnings forecasts of analysts for the short horizon with assumptions on firm profitability in the long run. In the first three years, expected earnings are taken from equity analysts. After year 3, expected earnings are obtained by applying the IBES consensus long-term earnings growth rate to expected earnings in year 3. In the stable growth phase after year 5, residual incomes are presumed to grow at the expected inflation rate g^l, which is calculated as the prevailing interest rate on 10-year treasury bonds less the assumed real-rate of three percent.[10]

To estimate equity duration, we first calculate the share's implied yield. The yield is obtained by solving the residual income model (12) for the internal rate of return, given the share price and expected cash flows. The solution is straightforward, since the RIM is monotone in k, and can be solved iteratively. Equity duration is then obtained by multiplying the slope coefficient of the pricing formula with $-(1+k)/P_0$, see equation (9).

The first step to estimate cash flow duration is to derive a hypothetical share price $\overline{P}_0$ by discounting expected cash flows at a uniform discount rate $\overline{k}$ of 10% for all firms, which corresponds roughly to the mean implied yield of the data sample of 9.83%. Then, similar to equity duration, cash flow duration is given by the product of the slope coefficient of the pricing formula and $-(1+\overline{k})/\overline{P}_0$.

4. DATA AND DESCRIPTIVE STATISTICS

4.1. Data

This study analyzes the usefulness of equity and cash flow duration to explain the cross-section of U.S. stock returns from January 1992 to January 2010.[11] Equity analyst earnings forecasts and long-term earnings growth predictions are obtained from IBES. We use the consensus forecasts of all contributing analysts, which are published on the third Thursday of each calendar month. To ensure that the duration estimates are based on publicly available information only, we employ share price data as of the same day, equally provided by IBES. Book value data are obtained from Worldscope since they are more reliable for accounting data than IBES. Monthly data on total stock returns are taken from Datastream.

We use the four Carhart (1997) firm characteristics to proxy for firm risk, i.e., market beta, firm size, B/M ratio, and price momentum. Market beta is the company's five year regressed return sensitivity on the market portfolio, measured by the CRSP index.[12] Market capitalization data are obtained from IBES. Price momentum is the change in stock prices over six months prior to each observation.

We include all non-financial firms[13] for which there is enough data to estimate the shares' durations, and for which we have the full set of the four Carhart risk proxies. We exclude penny stocks from the sample. Furthermore, we drop all observations with a negative book value of equity. Finally, we remove the lowest and highest 0.5% of the duration estimates and the Carhart risk variables to reduce the impact of outliers.

4.2. Descriptive statistics

Table 1 reports the descriptive statistics. The mean equity duration is around 19 years. In other words, shareholders expected to wait on average 19 years to get back the money from their investment. This estimate is considerably higher than studies that measure a share's price sensitivity to changes in the risk-free rate only, which yields estimates from two to six years (Leibowitz and Kogelman, 1993). Thus, it is essential to include firm-specific risk premia when estimating equity duration. A comparison with the equity duration proxies derived from the Gordon (1962) model in section 3.1 suggests that the estimates are plausible. The price-to-dividend approximation of equation (6) says that a dividend yield of 5% implies an equity duration of 20 years. The mean cash-flow duration is with 16.8 years slightly lower than the average equity duration. Not surprisingly, applying a uniform discount rate across firms yields to a considerably lower cross-sectional variation of cash flow duration.

The average implied yield (i.e., expected return) of around 10% is in line with previous studies (Claus and Thomas, 2001; Gebhardt et al., 2001; Lee et al., 2009). Given that the average return on ten-year government bonds was 5.3% over this period, the estimates imply an equal-weight market risk premium of 4.5%. The equal-weight market beta is with 1.06 just above the theoretical (value-weight) value of 1. The mean 5-year expected earnings growth rate seems with almost 18% rather high, but is largely driven by high expected growth rates of smaller companies. The average firm size of the sample is at around USD 3,600 million. The B/M ratio is at 0.33, and the 6-month price momentum is around 4.5%.

Figure 1 displays the average equity and cash flow duration from 1992 to 2010. The aggregate equity duration moves in a rather narrow range between 17 and 22 years, suggesting that the relation between stock market valuation and present value of expected market cash flows is rather stable over time. Only during recessions, especially the Great Recession 2008/09, the market equity duration dropped to record lows, caused by low prices compared to expected cash flows.

In contrast, the mean cash flow duration declines over the sample period from around 20 years to 14 years. This decline reflects the decrease in the firms' nominal expected cash flow growth rates, which is especially pronounced around the two recessions. This decrease in nominal growth rates mirrors the decline in (expected) inflation rates from 1992 to 2010.

5. EQUITY DURATION, CASH FLOW DURATION, AND FIRM RISK

This section analyzes the relation between equity duration, cash flow duration, and several measures of firm risk. Panel A of table 2 reports the correlation statistics, where we use the natural logarithm of firm size and the B/M ratio to reduce their skewness. As a second assessment, we sort all stocks, each month, into five quantiles based on the shares' equity and cash flow durations, respectively. Different from the correlation matrix, sorts do not assume a linear structure between the variables. Panels B and C presents the average firm characteristics of these five sub-samples.

The table allows for several important insights. First, the table documents a positive association between expected returns, cash flow duration, and expected earnings growth rates. Since cash flow duration and earnings growth both measure a firm's expected cash flow timing, this result implies that long-horizon equity bears higher risk than short-horizon stocks – the term structure of equity yields is upward-sloping. This finding is opposed to the duration-based explanation of the value premium (Lettau and Wachter, 2007) which assumes a downward-sloping equity yield curve.

In contrast, the table presents a strong negative relation between expected returns and equity duration. This pattern is expected: firms with high expected returns have a short equity duration because distant cash flows are heavily discounted and hence carry little weight, see equation (5).

Although equity and cash flow duration are estimated from the same cash flow data, both duration measures are little related to each other, see panel A. This follows directly from the two previous findings. If the equity yield curve is upward-sloping, firms with high growth rates have not only a long cash flow duration, but also high expected returns. Their cash flows are discounted at a higher rate, such that the equity duration is shorter. In the data, these two effects cancel out, i.e., the effect of a higher growth rate on a share's equity duration is offset by an increase in expected returns, on average.

Next, cross-sectional differences expected returns cannot be explained by market beta. The long equity duration portfolio with low expected returns has even a higher systematic risk exposure than the short equity duration portfolio (see panel B). This pattern is even more pronounced for cash flow duration. Especially long cash flow duration stocks bear substantial systematic risk, matching the empirical studies by Cornell (1999*b*) and Dechow et al. (2004), and the model by Brennan and Xia (2006).

In line with the value premium, there is a positive association between the B/M ratio and expected returns – value stocks are riskier. Next, value stocks are expected to grow considerably slower than growth stocks, different from their actual (realized) growth rates (Chen, 2014). The table also documents a negative association between equity and cash flow duration, and the B/M ratio. In other words, value stocks have a shorter cash flow maturity than growth stocks, and vice versa. The negative association between equity duration and B/M ratio fits with the notion that the inverse B/M ratio is a proxy for a share's equity duration, see equation (6).

The small size effect is also present in the data, as small stocks have on average higher expected returns than large stocks, see panel A. Furthermore, the negative association between firm size and earnings growth suggests that small firms are expected to grow faster. There is a positive relation between equity duration and firm size, but a negative relation between cash flow duration and firm size. This is intuitive: small firms carry high risk premia, such that their cash flows are discounted at a high rate, leading to short equity durations. At the same time high expected growth rates of small firms result in long cash flow durations.

Finally, there is a positive association between duration and price momentum. This relation is particularly strong for equity duration: ceteris paribus, a rise in share prices means that an investor has to wait longer for the amortization of a stock investment.

Overall, this section presents some important insights into the relation between equity duration, cash flow duration, and the value premium. In line with the intuition, the average cash flow timing of value stocks – as measured by cash flow duration – is shorter relative to growth stocks. Yet, different from the duration-based explanation of the value premium, short-horizon stocks have lower (expected) returns than long-horizon stocks, consistent with an *upward-sloping equity yield curve*. Instead, there is a negative association between equity duration and firm risk. This *downward-sloping equity duration curve* implies that higher expected returns for value stocks must be a compensation for firm risk not captured by the firms' cash flow timing.

6. EQUITY DURATION, CASH FLOW DURATION, AND STOCK RETURNS

Against the backdrop of the previous results, this section examines the relation between both duration measures and subsequent stock returns. In addition, we examine to what extent equity and cash flow duration capture the explanatory power of the traditional Fama-French value factor, and hence can explain the value premium.

6.1. Sorts

Portfolio sorts allow for a simple assessment how average returns vary depending on the shares' durations. Besides, sorts do not impose any functional form on the relation between equity duration, cash flow duration and stock returns. However, there might be some problems related to this approach. First, short-duration stocks tend to be past losers, while long-duration stocks tend to be past winners, see table 2. To prevent that short-term reversals in stock returns dominate subsequent portfolio returns, we skip the first month and report portfolio returns from the second month on. Second, Asparouhova et al. (2013) show that temporary deviations of prices from fundamental values can bias estimates of average returns when using equal-weight portfolios. To mitigate these concerns, we also report value-weight portfolio returns. Table 3 shows the average equal-weight and value-weight returns for the portfolios based on the shares' equity and cash flow durations for holding periods from one to twelve months. For periods longer than one month we present overlapping returns.

Panels A and B show that portfolios with a short equity duration provide on average higher returns than portfolios of long equity duration stocks. The return differential between short and long duration stocks is significant, in many cases at high confidence levels, and increases more or less proportional to the investment horizon. In most cases, the portfolio returns decrease monotonically in the portfolios' average equity duration. Short and long duration stocks exhibit even larger differences in returns when using value-weight portfolios rather than equal-weight portfolios. In contrast, panels C and D show that there is little difference in average returns across portfolios constructed according to the shares' cash flow duration. Although there is a small positive relation between the firms' cash flow maturity and subsequent stock returns, the spread in returns between short and long cash flow duration stocks is not significant.

The results are consistent with the previous section. Not only expected stock returns are decreasing in the shares' equity durations, but realized stock returns as well. Table 3 also confirms the previously documented positive relation between expected stock returns and cash flow duration for realized returns, although the cash flow sorts fail to be significant.

6.2. The cross-section of stock returns

A negative relation between equity duration and stock returns does not necessarily imply that equity duration is a priced risk factor, as the equity duration portfolios are exposed to other common risk factors that determine stock returns. Most of all, table 2 shows that short equity duration portfolios tend to have high B/M ratios and a low average firm size. Considering the ample evidence that firm size and price-to-fundamental ratio are priced risk factors, high returns of short-horizon equity might be subsumed and better explained by the shares' exposure to the value or size factor. Since sorts do not allow disentangling the relation between stock returns and duration from other risk effects, this section uses cross-sectional regression tests of individual firm data.

We run univariate and multiple regressions. In univariate regressions, we regress stock returns $r_{i,t+1}$ on the duration estimates $D_{i,t}$,

$$r_{i,t+1} = \alpha + \delta D_{i,t} + u_{i,t},$$

where the subscript i denotes the company (cross-sectional dimension), t denotes the time of the observation (time-series dimension) and $u_{i,t}$ the disturbance term. The multiple regressions use the market risk-adjusted stock returns $\tilde{r}_{i,t+1}$ as dependent variable,

$$\tilde{r}_{i,t+1} = \alpha + \delta D_{i,t} + \gamma' X_{i,t} + u_{i,t}, \tag{13}$$

where $X_{i,t}$ collects the Carhart (1997) risk characteristics firm size, B/M ratio and price momentum to control stock returns for firm-risk effects. Similar to Brennan et al. (1998), market risk-adjusted stock returns $\tilde{r}_{i,t+1}$ are calculated as

$$\tilde{r}_{i,t+1} = r_{i,t+1} - r^f_{t+1} - \beta_{i,t}(r^m_{t+1} - r^f_{t+1}),$$

where r^f_{t+1} is the risk-free rate, r^m_{t+1} the market return, and $\beta_{i,t}$ the market beta of firm i. We use the natural logarithm of firm size and the B/M ratio to reduce their skewness. In line with the literature, we estimate equation (13) using the two-pass Fama and MacBeth (1973) regression approach.[14] Similar to section 6.1, we skip the first month to prevent short-term reversals in stock returns to dominate subsequent returns.

Panel A of table 4 presents the results for the cross-section of monthly stock returns. As a benchmark, the first two rows report regressions of stock returns on the B/M ratio and multiple Carhart regressions, without equity and cash flow duration as explanatory variables. Different from Fama and French (1992, 2008), the B/M ratio is negatively related to stock returns. Although table 2 shows that value stocks have on average higher expected returns than growth stocks, the firms covered in this study do not exhibit a value premium for realized returns.[15] In line with Fama and French (1992), firm size exhibits a negative relation to stock returns – small companies are riskier. Finally, in contrast to Jegadeesh and Titman (1993), the stocks in the sample do not exhibit a momentum effect.

Against this backdrop, we turn to the relation between equity duration and stock returns. Similar to the portfolio sorts, a univariate regression shows that stocks with a short equity duration provide higher average returns. More important, when controlling stock returns for the firms' exposure to the Carhart risk proxies, the equity duration coefficient remains highly significant. Above all, B/M ratio and firm size do not subsume the explanatory power of the equity duration. This result means that the equity duration effect is independent of other firm-risk effects.

The results are again different when looking at the cash flow duration regressions. Similar to the sorts, a univariate regression confirms a slight positive relation between stock returns and cash flow duration, although the coefficient is not significant. When accounting stock returns for other firm risk exposure, the cash flow duration coefficient flips sign, and is negatively related to stock returns. This follows from the close association between cash flow duration, firm size and market beta as shown in table 2. In multiple regressions, the risk indicators explain a large fraction of the cross-sectional variation in stock returns, such that cash flow duration captures some remaining, negative effects. Compared to equity duration, the cash flow duration coefficient is less significant.

The coefficients and the predictive power of monthly cross-sectional regressions are small. Given that stock returns follow a random walk over the short horizon, this might be expected. Panel B of table 4 presents the results when extending the time horizon up to 12 months.[16] When increasing the time horizon, the estimated coefficients and the explained variance of the regression increase accordingly. Similar to the sorts presented in section 6.1, the overall picture does not change considerably when extending the time horizon. In both univariate and multivariate regressions, equity duration is more related to stock returns than cash flow duration.

These results substantiate the view that equity duration is a measure of equity risk, going beyond the risk-return trade-off implied by standard risk measures. However, a firm's expected cash flow timing, as measured by cash flow duration, is not consistently priced in equity markets. The explanatory power of equity duration for stock returns therefore originates from cross-sectional differences in the shares' expected returns, and not their cash flow timing. Taken together, the findings again cast doubt on the duration-based explanation of the value premium (Lettau and Wachter, 2007).

6.3. Equity duration factor model

The previous sections present considerable evidence that equity duration is a priced risk factor. Given that the B/M ratio can be interpreted as a noisy proxy for equity duration, see equation (6), we now directly test whether the value factor HML of the Fama and French (1993) asset pricing model can be explained by an equity duration factor. To test this hypothesis, we compare the average pricing errors of the Fama and French (1993) model with those of an alternative model where the value factor is replaced by an equity duration factor.[17]

We construct the equity duration factor for the period from January 1992 to January 2011 by replicating the approach by Fama and French (1993) to calculate the value factor. First, we form at the end of each June six value-weight portfolios, which are the intersections of 2 portfolios on market size and 3 portfolios on equity duration. The size breakpoint is the median size of the individual firm data set at the end of June. The equity duration breakpoints are the 30 and 70 percentiles, measured at the end of December of the previous year. The portfolios are rebalanced every 12 months. The duration factor SML (short-minus-long) is the monthly return of an equally weighted portfolio that is long in the two short-duration portfolios and short in the two long-duration portfolios. The data for the Fama-French factors are from Kenneth French's web-site.

Panel A of table 5 summarizes the descriptive statistics of the factor returns. Although individual value stocks do not provide above-average returns, the value factor HML is positive over the sample period. With a return of 0.45% per month, the duration factor SML provides slightly higher returns than the value factor. In line with the conjecture that B/M ratio and equity duration capture similar effects, the correlation matrix documents a strong relation between the HML and SML factors, reaching 60%.

We adopt the two-stage cross-sectional regression approach following chapter 12 of Cochrane (2005), using the 25 value-weight Fama-French size and book-to-market sorted portfolios as test assets. In the first step, we regress the monthly excess returns of the 25 portfolios, equally obtained from the web-site of Kenneth French, on the market excess return, the size factor and the duration factor,

$$r_i - r_f = \alpha_i + \beta_{i,M}(r_m - r_f) + \beta_{i,SMB} SMB + \beta_{i,SML} SML + u_i. \qquad i = 1, ..., 25$$

This gives the betas (or factor loadings) of the 25 portfolios. In the second stage, the sample averages of the monthly portfolio excess returns are regressed on the betas without intercept to obtain the risk premia for each factor λ,

$$\overline{r_i - r_f} = \hat{\beta}_{i,M} \lambda_M + \hat{\beta}_{i,SMB} \lambda_{SMB} + \hat{\beta}_{i,SML} \lambda_{SML} + v_i.$$

The model mispricing for each portfolio is given by

$$\hat{\alpha}_i = \overline{r_i - r_f} - \hat{\beta}_{i,M} \hat{\lambda}_M + \hat{\beta}_{i,SMB} \hat{\lambda}_{SMB} + \hat{\beta}_{i,SML} \hat{\lambda}_{SML}.$$

Panel B of table 5 presents the results for the Fama and French (1993) model; panel C for the equity duration factor model where the value factor HML is replaced by the equity duration factor SML. The table shows that the duration model has lower average pricing errors than the Fama and French (1993) model. In addition, the duration coefficient is almost twice as large, which results also in a higher statistical significance of the estimated coefficient. The analysis strengthens the view that equity duration is a priced risk factor. Equity duration has even a slight edge over the B/M ratio to explain the cross-sectional variation of stock returns. We acknowledge that the estimations have rather low power. The χ^2-test statistic rejects the hypothesis of insignificant pricing errors for both factor pricing models ($p < 1\%$), and the market and SMB factors are not significantly priced. The low power might result from the rather short period of the analysis.[18]

7. ADDITIONAL TESTS

This section presents additional tests and robustness checks. The next section compares the duration measures proposed in this paper to alternative duration measures. Section 7.2 discusses the results of a simulation study. Finally, section 7.3 examines whether the main results are influenced by potential biases of analyst forecasts.

7.1. Alternative duration measures

This section compares the analyst-based duration measures proposed in this study to alternative measures of equity and cash flow duration. Since recent research questions the superiority of analyst forecasts over time-series forecasts (Bradshaw et al., 2012), we re-estimate the firms' equity and cash flow duration using time-series earnings forecasts. Following Fairfield et al. (2009), we model the firms' return on equity as an economy-wide AR(1) process. Expected earnings are obtained by applying the predicted profitability from the AR(1) model to current book values of equity. In addition, we model the firms' earnings as a random walk, which serves as a natural benchmark for any forecasting model. Similar to the analyst-based duration estimates, we use the residual income model (12) to estimate equity and cash flow duration using these time-series forecasts. Following the derivations in section 3.1, we also use the firms' valuation ratios, such as the P/E ratio or the P/D ratio, as simple approximations of equity duration.

We also replicate the duration measures proposed by Dechow et al. (2004) and Da (2009) for our data sample. Dechow et al. (2004) estimate an equity duration relating observable market prices to expected cash-flows, similar to this paper. Unlike us, they predict future cash flows for the next 10 years by applying an autoregressive process on current fundamentals. The projected cash flows are discounted at a uniform rate of 12% across all firms. The difference between the present value of cash flows of the first 10 years and the share price is attributed to a terminal value with a duration that is identical for all companies. Conceptually, the duration by Dechow et al. (2004) combines features of cash flow duration (assuming of a uniform, exogenous discount rate) and equity duration (using price information). Hence, their implied equity duration can be considered a hybrid measure between equity and cash flow duration.

We also replicate the ex-post cash flow duration proposed by Da (2009). Different from all other duration concepts, Da (2009) suggest using the firms' ex-post observable, actual earnings when calculating cash flow duration. Since the estimation requires actual earnings data, we can estimate the ex-post cash flow duration up to 2006 only. Similar to other cash flow duration measures, earnings are discounted at an exogenously specified rate identical for all companies.

Panel A of table 6 provides an overview on the various duration measures. Since some of the alternative measures require more data, a comparison across the different duration estimates is possible for a sub-sample of firms only, with 206,453 observations.[19] Nevertheless, the composition of the sample is more or less identical to the main sample.

Since random walk forecasts imply no growth, the cash flow durations based on the random walk model are relatively short. In turn, their equity durations are rather long. In contrast, the duration measures obtained from AR(1) processes are rather similar to those obtained from analysts. As the sample includes periods with rather high valuation levels, such as the stock market bubble around the year 2000, the price-to-fundamentals ratios are relatively high compared to their long-run historical averages. Since the Dechow et al. (2004) duration applies a uniform discount rate for all firms, its standard deviation is rather small, similar to the various cash flow duration estimates. Finally, the Da (2009) ex-post duration estimates are the highest on average.

The correlation matrix in panel B shows that the various equity duration measures are rather similar, partly exhibiting high pair-wise correlations. Out of the different equity duration measures, the P/E ratio has the highest association with the analyst-based approach. The three cash flow duration estimates considered in this robustness test are even more related to each other.

Despite applying an exogenous discount rate across firms, the Dechow et al. (2004) duration is more related to the various measures of equity duration rather than cash flow duration, thereby confirming the hybrid nature of this duration concept. The ex-post duration by Da (2009) is little related to any duration estimates, suggesting that estimating duration from realized earnings results in rather different estimates to those based on expected earnings. In fact, the correlation between ex-post cash flow duration and the expected earnings growth is even negative. The table also shows that there is almost no correlation between Da (2009) cash flow duration and the B/M ratio, similar to Chen (2014). Growth firms (low B/M ratio stocks) have no significantly longer ex-post cash flow durations than value firms (high B/M ratio stocks).

The table also shows that the correlation between expected returns and cash flow duration is positive for various measures of cash flow duration. Hence, one of the main findings of the paper, an upward-sloping equity yield curve, is robust to different methods to estimate cash flow durations.

Panels C and D analyse and compare the ability of the various duration measures to predict the cross-section of stock returns. Panel C reports the average monthly returns of equal-weight and value-weight portfolios that are long in long-duration stocks and short in short-duration stocks, similar to the analysis in section 6.1. Panel D analyzes the predictive power of the duration measures for subsequent returns using Fama-MacBeth regressions, similar to section 6.2.

The tables underline a clear difference in the predictive power of equity duration and cash flow duration. With the exception of the B/M ratio, all equity duration measures are negatively related to stock returns, i.e., short duration stocks provide on average higher returns than long-duration stocks. In direct comparison, the AR(1)-based equity duration performs equally well in explaining the cross-section of stock returns as the analyst-based equity duration. In contrast, the various cash-flow duration measures are positively related to stock returns. Put differently, equities that pay cash flows in the distant future provide on average higher returns. Compared to the analyst-based cash flow duration, this pattern is even more pronounced when using time-series earnings forecasts. All in all, these findings show that the main results are robust to using different earnings forecasts.

Finally, we do not find any relation between the Dechow et al. (2004) duration and stock returns. Given that the Dechow et al. (2004) duration captures some elements of both cash flow and equity duration, this result is maybe not surprising as both effects work in opposite directions.

7.2. Simulation study

The positive association between expected returns, expected earnings growth and cash flow duration is consistent with an upward-sloping equity yield curve. Since there is no established market for dividend strips of individual companies, it is difficult to directly estimate an equity yield curve. To shed further light on the relation between expected stock returns and the shares' durations, and to cross-check that the previous results are not driven by noise, we conduct a simulation study.

We simulate a cross-section of 1,000 firms with firm-specific discount rates and cash flow streams for a time horizon of 200 years. Firm-specific discount rates are assumed to consist of two components, a market term structure of equity yields and a firm-specific component. In line with the empirical evidence presented in this paper, the market term structure of equity yields is assumed to be upward-sloping. The firm-specific component of discount rates is assumed to be lognormally distributed.

The simulation of the firms' cash flow streams is based on the two-stage residual income model (12), similar to the estimation approach. First year earnings and earnings growth rates up to year 5 are assumed to be lognormal. Earnings growth rates are determined by two independent random components, a time-series component which is identical across all firms, and a firm-specific component that generates some cross-sectional variation in growth rates. Following the residual income model, earnings beyond year 5 are determined by an assumed long-term growth in residual incomes.

The simulated data are used to calculate the firms' share prices. Implied yields, equity and cash flow durations are then obtained by applying our estimation approach to share price and simulated cash flow data.

The simulation parameters governing discount rates, earnings and earnings growth rates are chosen such that the means and standard deviations obtained from the simulated data match those of the actual data. Furthermore, the slope of the equity yield curve is chosen such that the correlation between expected returns and cash flow duration matches the correlation observed in the data.[20]

Panel A of table 7 presents the main simulation parameters. Short-term equity yields are at 8.2%. In contrast, long-term equity yields are with 10.5% more than 2% higher, i.e., the equity yield curve is upward-sloping. The long-term growth rate in residual incomes is assumed to equal 2.6%. Panels B and C present the means and standard deviations of the estimates obtained from the simulated and the actual data. The distributions of expected returns and expected earnings growth rates of both data sets are almost identical since the simulation parameters are chosen such that these distributions match. More important, the distribution of equity duration and the B/M ratio in the simulated data matches the actual distribution remarkably well. Only the mean cash flow duration is slightly shorter in the simulated data.

Finally, panel D compares the correlation statistics between the key variables obtained from both data sets. The correlation between expected returns and cash flow duration is 0.224 in both simulated and actual data, since the slope of the equity yield curve is constructed such that the two figures match. Most of the other correlations obtained from the artificial data are aligned to those of the original data. Similar to the actual data, equity and cash flow duration are little related to each other. The simulation also generates a strong negative correlation between equity duration and expected returns, and reproduces the negative relation between both duration measures and the B/M ratio. The only noticeable difference between the simulated and the actual data regards the connection between cash flow duration and expected earnings growth, which is much higher in the simulated data. We conclude that the simulation study largely confirms the main empirical results of this study.[21]

7.3. Biases in analyst forecasts

Using analysts' cash-flow forecasts to estimate the firms' duration rests upon the assumption that these forecasts accurately reflect the marginal investor's expectations about future cash flows. However, analyst forecasts might be biased due to conflicts of interests (Chan et al., 2007; Ljungqvist et al., 2009) and therefore not a valid proxy for the investors' true expectations. Yet, biased analyst forecasts are not likely to have a major impact on our results.

First, a market-wide bias in analyst forecasts leaves the cross-sectional variation in equity duration unchanged – only the average duration might be biased. Second, to the extent that market participants believe in biased forecasts, forecast and pricing errors cancel each other out. The main concern addressed in this robustness check is therefore a possible systematic relation between forecast bias and a firm's duration that might drive the previous results.

Following Chava and Purnanandam (2010) and Chen et al. (2013), we use several alternative forecast measures that correct for potential biases. First, we use the most optimistic and the most pessimistic earnings forecast instead of the consensus forecast. The idea is that, even if there is a bias when using the consensus forecast, the bias is smaller if the lowest or highest forecasts are used. Second, we adjust the forecasts by the extent to which companies rely on external financing. Analysts tend to be more optimistic when there is a large investment banking demand. Bradshaw et al. (2006) suggest measuring the investment banking business as the amount of external cash financing. Similar to Chava and Purnanandam (2010), we rank all firms, each year, based on the amount of net external funding (debt and equity issues) and calculate the percentile ranking EF_i for each firm i. The external-financing-adjusted forecast is

$$EPS_i^{EF} = EF_i \times LowEPS_i + (1 - EF_i) \times HighEPS_i,$$

where $LowEPS_i$ and $HighEPS_i$ are the most pessimistic and the most optimistic analyst earnings forecasts, respectively. The adjusted forecast hence relies more on the pessimistic forecast if a firm's investment banking demand is high, and vice versa. Third, we correct the forecasts by the most recent forecast error. Since forecast errors tend to be persistent (Abarbanell and Bernhard, 1992), current forecasts are likely to be pessimistic (optimistic) if they were pessimistic (optimistic) in the past. We rank all firms, each year, based on the consensus earnings forecast error of the most recent fiscal year. For a firm i with a percentile ranking FE_i, the corrected earnings forecast is

$$EPS_i^{FE} = FE_i \times LowEPS_i + (1 - FE_i) \times HighEPS_i.$$

The idea is to rely more on the optimistic forecast if there was a negative forecast error in the recent past.

Panel A of table 8 reports the descriptive statistics of the duration estimates based on the adjusted forecasts measures. As expected, when using the most pessimistic forecasts, the mean equity duration is slightly higher. Using the most optimistic forecast decreases average equity durations accordingly. The average equity durations based on the external-financing-adjusted and forecast-error-adjusted forecasts are in-between. In contrast, the mean cash flow duration is similar for the various alternative forecast measures. This again demonstrates that cross-sectional differences in equity duration are largely driven by differences in expected returns, and not by differences in expected cash flow growth rates (see also the online appendix A).

Panel B reports the average monthly return of a portfolio that is long in long-duration stocks and short in short-duration stocks using the corrected duration estimates, similar to section 6.1. Panel C reports the results of univariate Fama-MacBeth regressions of stock returns on the various adjusted duration measures, as well as multiple regressions that control the stock returns for their exposure to the Carhart (1997) firm risk characteristics.

The results are fairly similar, and in line to those based on the consensus forecasts. As before, there is a significant relation between equity duration and stock returns. In the regressions, only the equity duration calculated based on the most pessimistic forecast is slightly less related to stock returns, although still significant at the 10% level. Similarly, there is no sustained relation between cash flow duration and returns. Taken together, the table shows that there is no evidence for a systematic relation between forecast bias and the shares' duration. Hence, forecast biases are unlikely to have a major impact on our results.

8. DISCUSSION

The first key result of this study states that (expected) stock returns are positively related to various measures of the firms' cash flow timing. This finding is consistent with an upward sloping *equity yield curve* – companies that pay more cash flows in the distant future have on average higher expected and realized returns than short-term equity.

An upward-sloping equity yield curve is at odds with the duration-based explanation of the value premium by Lettau and Wachter (2007, 2011), which suggests a firm's cash flow timing is a major source of equity risk. Other things equal, an upward-sloping equity yield curve would imply a discount rather than a premium for short-duration value stocks. Yet, our empirical results are consistent with many asset pricing models, such as the habit formation model (Campbell and Cochrane, 1999) or the long-run risk-model (Bansal and Yaron, 2004) that produce a growth premium rather than a value premium. Our finding is also in line with the empirical evidence by Binsbergen et al. (2013) who show that the equity yield curve is on average upward-sloping, with the exception of the 2001 recession and the Great Recession 2008/09.

The results by Binsbergen et al. (2013) suggest that the term structure of equity yields can change over time, and that the equity term structure spread can flip sign, similar to the term structure of interest rates. We therefore check whether we find a similar pattern in the data. Given that that the correlation between expected returns and cash flow duration reveals some information about the average slope of the equity yield curve, we examine correlation between these two variables over time.

Figure 2 pots the correlation between expected returns and cash flow duration from 1992 to 2010. While at the beginning of the sample period in the 1990s, the correlation between expected returns and the firms' cash flow timing of firms is highly positive, the relation weakens over time, and disappears altogether at the end of the sample period in 2010. This pattern is consistent with a positive, but steadily flattening equity yield curve. As such, the figure confirms that the term structure of equity yields is indeed time-varying, similar to Binsbergen et al. (2013). Although not exactly identical, the pot also matches the decrease in the equity term structure spread in the wake of the Great Recession.

The second major result of this study is that companies with a short equity duration have both higher expected and realized returns than companies with long equity durations. Put differently, the *equity duration curve* is downward sloping, similar to the finding by Dechow et al. (2004). The negative association between equity duration and (expected) stock returns is a consequence of the mechanical discount rate effect of equity duration. The higher a firm's expected rate of return, the more heavily distant cash flows are discounted, such that cash-flow weighted average time to maturity decreases.

The downward-sloping equity duration curve also helps explaining our third result, that equity duration can explain the value effect in stock markets. Value stocks have not only shorter cash flow durations (and lower expected earnings growth rates) than growth stocks, but also significantly shorter equity durations, caused by higher excepted returns.

These empirical results confirm the view that the value premium is a compensation for the value firms' exposure to cash flow risk. Since equity duration is derived from a share's price sensitivity to changes in discount rates, it is a measure of discount rate risk. Yet, low (expected) stock returns for long equity duration stocks show that discount rate risk is not priced. High market betas of short equity duration stocks are hence a sign for their exposure to cash flow risk. Under the premise that cash flow risk carries higher risk premia (Campbell and Voulteenaho, 2004), short-duration value stocks provide higher returns. This explanation is also consistent with the works by Da (2009) and Santos and Veronesi (2010) that highlight the importance of cash covariance or cash flow risk for the cross-section of stocks returns.

9. CONCLUDING REMARKS

This paper examines the relation between the expected cash flow maturity of firms and the cross-section of stock returns. We measure the firms' average cash flow maturity by estimating their equity and cash flow duration. Our approach of deriving equity and cash flow duration from a share's price sensitivity to changes in discount rates allows estimating an equity and cash flow duration for individual shares. By using analyst forecasts as proxy for the firms' expected cash flows we ensure that our duration estimates are entirely forward-looking. Since market prices essentially reflect expectations, this approach is conceptually more consistent than earlier attempts to estimate the duration of shares.

This paper shows that the value premium can be explained by cross-sectional differences in the shares' equity duration, but not by their cash flow duration. This result casts doubt on the duration-based explanation of the value premium by Lettau and Wachter (2007) that explains the value premium with cross-sectional differences in the firm's cash flow timing. Our results show that the value premium is rather a compensation for the value firms' equity risk not captured by the market beta. Since value firms with front-loaded dividends are less exposed to discount rate risk, the value firms' equity risk can be largely attributed to their exposure to cash flow risks. Hence, the value premium is a cash flow risk premium.

The results of this paper have interesting implications for both academics and practitioners. By showing that the equity yield curve is time-varying and – on average – upward-sloping, our paper might provide guidance to the theoretical asset-pricing literature on modelling equity yield curve. On the other hand, the equity duration concept put forward in this paper can be useful for investment managers of pension funds that seek to assess their portfolio's sensitivity to changes in discount rates. It can help trustees to ensure a better match between their investments across asset classes and pension liabilities without sacrificing too much of potential returns.

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Notes

[1]The literature has suggested alternative explanations of the value premium. Most studies propose macroeconomic foundations, e.g., Liew and Vassalou (2000), Vassalou (2003), Brennan et al. (2004), Parker and Julliard (2005), Zhang (2005), Hahn and Lee (2006) and Petkova (2006). For a comprehensive review, see Cohen et al. (2003), Phalippou (2007), and Lettau and Wachter (2007).

[2]Section 2 presents the duration-based explanation of the value premium in more detail and discusses its relation to competing asset pricing models.

[3]The duration estimated by Dechow et al. (2004) is neither an accurate measure of equity duration, nor is it a good measure of cash flow duration, see section 7.1.

[4]Using the log-linear approximation of stock returns of Campbell and Shiller (1988) and Campbell (1991), Campbell and Mei (1993), Campbell and Voulteenaho (2004), Bansal et al. (2005) and Campbell et al. (2009) use a VAR to decompose unexpected returns into returns following shocks about future cash flows and shocks about the discount rate, and derive the corresponding cash flow and discount rate betas.

[5]The implied yield (or ICC) is commonly used as estimate of a share's expected rate of return. By aggregating the ICC over entire markets, it has been used to estimate an expected equity risk premium (Cornell, 1999*a*; Gebhardt et al., 2001; Claus and Thomas, 2001). Recent studies use the ICC to test asset pricing models (Lee et al., 2009), to analyze the risk-return trade-off of shares (Pástor et al., 2008; Chava and Purnanandam, 2010), or to predict market returns Li et al. (2013).

[6]This definition of equity duration captures a share's price sensitivity to changes in the discount rate, i.e., the sum of risk-free rate and a firm-specific risk premium. Leibowitz (1986) or Cornell (2000) define equity duration as a share's price sensitivity to changes in the risk-free rate only. Although such an analysis is equally interesting, it does not correspond to the initial concept of bond duration that establishes a relation between the price of a security and its proper yield. Furthermore, a completely risk-free rate is a rather theoretical concept.

[7]In the Gordon (1962) model, there is a one-to-one match between cash flow growth and cash flow timing.

[8]Analyst forecasts might be biased due to conflicts of interests. Robustness checks in section 7.3 show that the results are unlikely to be affected by potential biases in analyst forecasts.

[9]Alternative implementations of the RIM are by Gebhardt et al. (2001), Gode and Mohanram (2003) or Easton (2004). A good summary of the different formulae can be found in Botosan and Plumee (2005), Easton (2006), and Botosan et al. (2011). In unreported tests, we checked the robustness of the results using different implementations of the RIM. The results are qualitatively similar.

[10]If there is no analyst forecast for earnings in year 3, we generate an expected earnings estimate by applying the long-term consensus growth rate to expected earnings in year 2. If projected earnings in year 3 (or in year 2, respectively) are negative, we drop the observation from the sample. Future expected book values are calculated using the clean surplus relation. The assumption of no real growth in residual income after year 5 does not imply the absence of real earnings growth after year 5. It rather incorporates the assumption of decreasing earnings growth rates in the stable growth phase, for usual reasons (competition, antitrust actions, etc.). For more details, see Claus and Thomas (2001).

[11]Limited equity analyst coverage prevents to extend this comprehensive analysis prior to 1992.

[12]If the share price is not available 60 months before any observation, the beta estimation period is reduced down to 24 months. If the available time period is even shorter, the observation is dropped from the sample.

[13]A sample that includes financial firms yields qualitatively similar results.

[14]Since Petersen (2009) shows that Fama-MacBeth regressions do not sufficiently correct for both cross-sectional and time-series dependence of standard errors, we also estimate equation (13) using a one-pass panel regression with two-way clustered standard errors (Rogers, 1993). The results are similar.

[15]The absence of a value premium might be explained by the sample composition, as large companies followed by equity analysts tend to exhibit a smaller value premium (Fama and French, 2006). The value factor HML, which provided an average return of 0.41% per month over the same period, contains smaller stocks not covered by equity analysts.

[16]Long-horizon regressions can be carried out using either overlapping or non-overlapping observations. Since Campbell (2001) shows that the use of overlapping observations increases the power of the regression, it is standard to run the regression over the whole overlapping data set (Fama and French, 1988; Chan et al., 1996).

[17]Given the weak relation between cash flow duration and stock returns we refrain from presenting a similar analysis using a cash flow duration factor.

[18]Brennan et al. (2004) obtain similarly weak results when analyzing short time periods.

[19]Since not all companies pay dividends, the D/P ratio is only available for 107,997 observations. Furthermore, since we can estimate Da (2009) ex-post duration only up to 2006, there are only 67,169 observations.

[20]See the online appendix B for a more detailed description of the simulation study.

[21]The online appendix B also provides simulations assuming a flat or downward-sloping equity yield curve. However, these scenarios fail to generate the correlation pattern observed in the actual data.

TABLES

Table 1: Descriptive statistics

	Mean	Std. dev.	25% centile	50% centile	75% centile
Equity duration	19.11	7.57	14.95	17.76	21.08
Cash flow duration	16.81	2.06	15.22	16.44	18.36
Expected return	9.83%	3.20%	7.79%	9.38%	11.31%
Expected growth	17.72%	44.20%	9.41%	15.34%	24.17%
Market beta	1.06	0.69	0.57	0.97	1.43
B/M ratio	0.33	0.66	0.06	0.17	0.39
Size (in mn USD)	3,549	8,161	308	898	2,816
Price momentum	4.53%	34.18%	−15.07%	2.28%	19.83%

The table summarizes the mean, standard deviation, and quartiles of the firms' equity duration, cash flow duration, implied expected return, predicted earnings growth rate, and the Carhart (1997) risk characteristics. Equity duration, cash flow duration and implied expected returns are derived from the two-stage RIM (Claus and Thomas, 2001), see equation (12). The expected growth is the mean of the expected annual earnings growth rates implied by the model up to year 5, i.e., in the growth period. Market beta is the company's five year regressed sensitivity on the market portfolio, measured by the CRSP index. Price momentum is the change in stock prices over six months prior to each observation. The sample period is from January 1992 to January 2010. Observations: 281,838.

Table 2: Equity duration, cash flow duration, and firm risk

Panel A: Correlation statistics

	Equity duration	Cash flow duration	Expected return	Expected growth	Market beta	B/M ratio	Firm size
Cash flow duration	−0.092						
Expected return	−0.778	0.224					
Expected growth	−0.088	0.088	0.104				
Market beta	0.056	0.395	0.039	0.057			
B/M ratio	−0.087	−0.158	0.177	−0.040	−0.046		
Firm size	0.091	−0.246	−0.240	−0.028	−0.104	−0.470	
Price momentum	0.153	0.037	−0.203	0.044	0.009	−0.107	0.045

Panel B: Equity duration sorts

Quintiles	Equity duration	Expected return	Expected growth	Market beta	B/M ratio	Size (in mn USD)	Price momentum
Q1 (short duration)	12.65	14.16%	23.56%	1.10	0.49	506	−5.63%
Q2	15.58	10.87%	17.69%	1.02	0.31	920	0.98%
Q3	17.65	9.55%	16.54%	0.98	0.26	1,210	5.06%
Q4	20.19	8.46%	16.41%	1.00	0.25	1,323	8.62%
Q5 (long duration)	29.04	6.73%	14.25%	1.17	0.34	1,065	12.54%
Q5-Q1	16.39***	−7.43%***	−9.32%***	0.07***	−0.15***	559***	18.18%***

Panel C: Cash flow duration sorts

Quintiles	Cash flow duration	Expected return	Expected growth	Market beta	B/M ratio	Size (in mn USD)	Price momentum
Q1 (short duration)	16.12	8.89%	13.30%	0.65	0.44	1,653	2.45%
Q2	16.82	9.97%	14.16%	0.90	0.22	1,794	3.37%
Q3	17.15	10.18%	16.83%	1.09	0.34	923	3.83%
Q4	17.43	10.26%	18.46%	1.23	0.34	579	5.09%
Q5 (long duration)	17.67	10.48%	25.69%	1.41	0.27	492	6.84%
Q5-Q1	1.55***	1.59%***	12.39%***	0.76***	−0.17***	−1,157***	4.39%***

The table presents the relation between the firms' equity duration, cash flow duration, implied expected return, predicted earnings growth rate, and the Carhart (1997) risk characteristics. Panel A presents the correlation statistics, calculated as the mean of the monthly cross-sectional correlations. We use the natural logarithm of firm size and B/M ratio to reduce their skewness. Panel B and C show the average firm characteristics of five quintiles constructed each month based on the firms' equity or cash flow duration, respectively. The differences between the quintiles Q5 and Q1 are statistically significant at the 1% level, using a t-test with unequal variances and the non-parametric Mann and Whitney (1947) U-test. For sample description and variable construction, see table 1.

Table 3: Equity and cash flow duration sorts

Panel A: Equal-weight equity duration portfolio returns

Portfolios	1 month	3 months	6 months	12 months
Q1 (short duration)	1.46%	4.41%	8.79%	18.68%
Q2	1.21%	3.59%	7.23%	16.03%
Q3	1.17%	3.56%	6.84%	14.25%
Q4	0.92%	2.90%	5.86%	12.61%
Q5 (long duration)	0.83%	2.74%	5.73%	12.01%
Q5-Q1	−0.63%***	−1.67%**	−3.07%*	−6.67%**
t-statistics	(−2.72)	(−2.34)	(−1.91)	(−2.18)

Panel B: Value-weight equity duration portfolio returns

Portfolios	1 month	3 months	6 months	12 months
Q1 (short duration)	1.26%	4.03%	8.12%	16.82%
Q2	0.96%	2.84%	5.59%	13.23%
Q3	0.95%	2.87%	5.67%	11.86%
Q4	0.77%	2.44%	4.72%	10.11%
Q5 (long duration)	0.61%	2.13%	4.48%	9.58%
Q5-Q1	−0.65%**	−1.90%**	−3.64%**	−7.24%**
t-statistics	(−2.38)	(−2.36)	(−2.21)	(−2.47)

Panel C: Equal-weight cash flow duration portfolio returns

Portfolios	1 month	3 months	6 months	12 months
Q1 (short duration)	0.90%	2.81%	5.68%	12.07%
Q2	1.06%	3.17%	6.27%	12.81%
Q3	1.05%	3.23%	6.42%	13.58%
Q4	1.23%	3.79%	7.57%	16.13%
Q5 (long duration)	1.33%	4.21%	8.51%	19.00%
Q5-Q1	0.43%	1.40%	2.82%	6.93%
t-statistics	(1.28)	(1.52)	(1.54)	(1.64)

Panel D: Value-weight cash flow duration portfolio returns

Portfolios	1 month	3 months	6 months	12 months
Q1 (short duration)	0.87%	2.69%	5.30%	11.14%
Q2	0.89%	2.68%	5.27%	10.98%
Q3	0.94%	2.90%	5.55%	11.64%
Q4	1.03%	3.16%	6.43%	14.42%
Q5 (long duration)	1.03%	3.43%	6.84%	15.88%
Q5-Q1	0.15%	0.75%	1.54%	4.74%
t-statistics	(0.36)	(0.71)	(0.76)	(1.01)

The table presents the returns of 5 portfolios based on the firms' equity and cash flow duration, respectively, for holding periods of 1 to 12 months. Q1 comprises the short-duration stocks, and Q5 the long-duration stocks. Q5-Q1 is the portfolio that is long in Q5 and short in Q1. Panels A and C report the equal-weight portfolio returns, panels B and D report the value-weight portfolio returns. To prevent short-term reversals in stock returns influence the portfolio returns, we skip the first month and include only returns from month 2 on. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors. For sample description and variable construction, see table 1.

Table 4: The cross-section of stock returns

Panel A: Monthly stock returns

	Equity duration	Cash flow duration	B/M ratio	Firm size	Price momentum	adj. R^2
(1)			−0.10%**			0.63
			(−2.10)			
(2)			−0.20%***	−0.18%***	−0.01%	2.44
			(−4.51)	(−2.96)	(−0.03)	
(3)	−0.03%***					0.57
	(−3.00)					
(4)	−0.03%***		−0.21%***	−0.17%***	0.09%	2.81
	(−3.53)		(−4.99)	(−2.86)	(0.30)	
(5)		0.23%				1.63
		(1.26)				
(6)		−0.24%**	−0.25%***	−0.22%***	0.04%	3.01
		(−2.08)	(−6.68)	(−4.25)	(0.13)	

Panel B: Long-horizon regressions

	Equity duration	Cash flow duration	B/M ratio	Firm size	Price momentum	adj. R^2
			3-month returns			
(1)	−0.07%**					0.77
	(−2.46)					
(2)	−0.07%***		−0.65%***	−0.53%***	0.59%	3.71
	(−2.98)		(−4.94)	(−3.11)	(0.75)	
(3)		0.76%				1.83
		(1.52)				
(4)		−0.69%**	−0.77%***	−0.66%***	0.42%	3.88
		(−2.23)	(−6.19)	(−4.44)	(0.52)	
			6-month returns			
(1)	−0.11%*					0.82
	(−1.88)					
(2)	−0.10%**		−1.26%***	−1.10%***	1.54%	3.90
	(−2.20)		(−4.42)	(−3.12)	(0.96)	
(3)		1.44%				1.52
		(1.46)				
(4)		−1.50%**	−1.51%***	−1.35%***	1.21%	4.15
		(−2.20)	(−5.36)	(−4.55)	(0.73)	
			12-month returns			
(1)	−0.25%**					0.80
	(−2.29)					
(2)	−0.18%*		−2.84%***	−2.58%***	0.08%	3.95
	(−1.79)		(−3.97)	(−3.09)	(0.02)	
(3)		3.55%				1.38
		(1.54)				
(4)		−2.64%	−3.25%***	−3.02%***	−0.28%	4.37
		(−1.47)	(−4.82)	(−4.47)	(−0.10)	

Annotation to table 4

The table reports Fama and MacBeth (1973) regressions of individual stock returns on the firms' equity and cash flow duration $D_{i,t}$ and the Carhart (1997) firm risk characteristics $X_{i,t}$. The univariate regressions use the simple stock return $r_{i,t+1}$ as dependent variable:

$$r_{i,t+1} = \alpha + \delta D_{i,t} + u_{i,t}.$$

The subscript i denotes the company (cross-sectional dimension), t denotes the time of the observation (time-series dimension) and $u_{i,t}$ the disturbance term. The multiple regressions use the market risk-adjusted stock returns $\tilde{r}_{i,t+1}$ as dependent variable.

$$\tilde{r}_{i,t+1} = \alpha + \delta D_{i,t} + \gamma' X_{i,t} + u_{i,t}.$$

The market risk-adjusted stock returns $\tilde{r}_{i,t+1}$ are calculated as

$$\tilde{r}_{i,t+1} = r_{i,t+1} - r^f_{t+1} - \beta_{i,t}(r^m_{i,t+1} - r^f_{t+1}),$$

where r^f_t is the risk-free rate, r^m_t the market return, and $\beta_{i,t}$ the market beta of firm i. We use the natural logarithm of firm size and the B/M ratio to reduce their skewness. To prevent short-term reversals in stock returns influence the portfolio returns, we skip the first month and include only returns from month 2 on.

Panel A reports the regression results for monthly stock returns, panel B the results for long-horizon (overlapping) stock returns up to 12 months. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. For a sample description and variable construction, see table 1.

Table 5: Cross-sectional regressions of the 25 size and B/M sorted portfolios, following Cochrane (2005)

Panel A: Summary statistics of factors

	$R_m - R^f$	SMB	HML	SML
Mean	0.502%	0.269%	0.411%	0.498%
Standard deviation	4.45%	3.57%	3.44%	2.68%
Correlation	$R_m - R^f$	SMB	HML	SML
$R_m - R^f$	1.000			
SMB	0.225	1.000		
HML	−0.254	−0.357	1.000	
SML	0.016	−0.012	0.593	1.000

Panel B: Fama and French (1993) three factor model

	λ_M	λ_{SMB}	λ_{HML}	
Coefficients	0.452%	0.250%	0.518%**	
t-statistics (Shanken)	(1.51)	(1.03)	(2.21)	
average $\hat{\alpha}$		0.010%		
$\alpha'\Sigma^{-1}\alpha$		90.8		
p-value		$< 1\%$		

Panel C: Equity duration factor model

	λ_M	λ_{SMB}		λ_{SML}
Coefficients	0.482%	0.240%		0.865%***
t-statistics (Shanken)	(1.60)	(0.98)		(3.17)
average $\hat{\alpha}$		0.006%		
$\alpha'\Sigma^{-1}\alpha$		76.0		
p-value		$< 1\%$		

The table reports the two-stage cross-sectional regression tests (Cochrane, 2005) of the Fama and French (1993) asset pricing model and the equity duration factor model, using the 25 value-weight size and B/M sorted portfolios as test assets.
Panel A presents the mean, standard deviation and correlation statistics of the market factor ($R_m - R^f$), the Fama-French factors (HML and SMB), and the duration factor (SML). The equity duration factor is constructed as the monthly return of an equally weighted portfolio that is long in two short-duration portfolios and short in the two long-duration portfolios, abbreviated short-duration minus long-duration stocks (SML). For more details on the construction of the SML factor, see section 6.3.
Panel B shows the results for the Fama and French (1993) model; panel C for the equity duration factor model where the HML factor is replaced with the duration factor SML. The λ's indicate the risk premia for each of the factors, $\hat{\alpha}$ is the average mispricing of each factor pricing model, and Σ the variance-covariance matrix of the pricing errors. The t-statistics and the variance-covariance matrix Σ are calculated using the adjustment of Shanken (1992).
*, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 6: Robustness: alternative duration measures

Panel A: Descriptive statistics

	Mean	Std. dev.	25% centile	50% centile	75% centile	Observations
Equity duration						
Analyst forecasts	18.21	5.81	14.82	17.45	20.31	206,453
AR(1) forecasts	18.76	9.76	12.78	17.01	22.18	206,453
RW forecasts	34.27	21.71	21.86	28.31	39.07	206,453
P/E ratio	21.88	14.22	13.45	18.32	25.80	206,453
P/B ratio	21.29	110.77	2.68	5.79	14.68	206,453
P/D ratio	85.55	107.79	29.21	50.63	93.62	107,997
Dechow et al. (2004)	16.80	2.53	16.24	17.38	18.05	206,453
Cash flow duration						
Analyst forecasts	16.59	1.98	15.08	16.21	18.11	206,453
AR(1) forecasts	16.71	2.01	15.15	16.33	18.29	206,453
RW forecasts	15.96	1.88	14.53	15.65	17.36	206,453
Da (2009)	40.34	22.03	26.01	36.77	50.90	67,169
Expected return	9.89%	3.01%	7.93%	9.42%	11.29%	206,453
Expected growth	16.70%	25.94%	9.63%	14.73%	21.79%	206,453
Market beta	1.00	0.66	0.53	0.91	1.35	206,453
B/M ratio	0.29	0.37	0.07	0.17	0.37	206,453
Size (in mn USD)	3,798	8,448	351	1,007	3,077	206,453
Price momentum	4.22%	31.30%	−13.69%	2.52%	18.83%	206,453

Table 6, continued

Panel B: Correlation statistics

	Equity duration: Analysts forecasts	Equity duration: AR(1) forecasts	Equity duration: RW forecasts	Equity duration: P/E ratio	Equity duration: P/B ratio	Equity duration: P/D ratio	Dechow et al. (2004)	Cash flow duration: Analysts forecasts	Cash flow duration: AR(1) forecasts	Cash flow duration: RW forecasts	Da (2009)
Equity duration											
AR(1) forecasts	0.270										
RW forecasts	0.370	0.618									
P/E ratio	0.410	0.695	0.859								
P/B ratio	0.138	0.074	0.143	0.403							
P/D ratio	0.078	0.093	0.288	0.304	0.329						
Dechow et al. (2004)	0.122	0.294	0.219	0.400	0.398	0.096					
Cash flow duration											
Analyst forecasts	−0.160	0.132	0.260	0.238	0.148	0.699	0.066				
AR(1) forecasts	0.018	−0.287	0.148	0.108	0.397	0.577	0.011	0.706			
RW forecasts	−0.046	0.056	−0.036	0.052	0.246	0.604	0.090	0.794	0.683		
Da (2009)	−0.133	−0.097	−0.168	−0.161	−0.016	−0.102	0.023	−0.112	−0.006	0.040	
Expected return	−0.819	−0.263	−0.308	−0.430	−0.190	0.033	−0.185	0.285	0.092	0.145	0.079
Expected growth	−0.149	0.246	0.322	0.312	0.076	0.219	0.093	0.253	0.105	0.087	−0.089
Market beta	−0.014	0.083	0.184	0.140	0.058	0.344	0.018	0.421	0.320	0.314	−0.075
B/M ratio	−0.138	−0.074	−0.143	−0.403	−1.000	−0.329	−0.398	−0.148	−0.397	−0.246	0.016
Size	0.142	0.007	−0.014	0.132	0.445	0.009	0.203	−0.263	−0.059	−0.153	0.396
Price momentum	0.171	0.243	0.240	0.306	0.129	0.132	0.221	0.022	0.011	0.031	0.102

Table 6, continued

Panel C: Sorts

	Monthly long-short portfolio returns equal-weight portfolios	Monthly long-short portfolio returns value-weight portfolios
Equity duration		
Analyst forecasts	$-0.45\%^{**}$	$-0.55\%^{**}$
	(-1.99)	(-2.10)
AR(1) forecasts	$-0.36\%^{*}$	$-0.69\%^{***}$
	(-1.85)	(-3.82)
RW forecasts	-0.30%	-0.33%
	(-1.19)	(-1.19)
P/E ratio	-0.16%	-0.33%
	(-0.63)	(-1.23)
P/B ratio	$0.48\%^{**}$	0.23%
	(2.55)	(1.09)
P/D ratio	-0.07%	-0.17%
	(-0.31)	(-0.54)
Dechow et al. (2004)	0.09%	-0.18%
	(0.43)	(-0.74)
Cash flow duration		
Analyst forecasts	$0.54\%^{*}$	0.36%
	(1.82)	(1.01)
AR(1) forecasts	$0.54\%^{**}$	$0.51\%^{**}$
	(2.42)	(2.19)
RW forecasts	$0.69\%^{***}$	$0.63\%^{*}$
	(2.91)	(1.96)
Da (2009)	$0.66\%^{***}$	0.53%
	(3.15)	(1.59)

Table 6, continued

Panel D: The cross-section of monthly stock returns

	Duration measure	B/M ratio	Size	Price momentum	adj. R^2
Equity duration					
Analyst forecasts	−0.03%**				0.59
	(−2.01)				
	−0.02%**	−0.23%***	−0.18%***	0.09%	2.90
	(−2.22)	(−5.70)	(−2.96)	(0.28)	
AR(1) forecasts	−0.02%*				0.59
	(−1.78)				
	−0.02%***	−0.25%***	−0.18%***	0.13%	2.94
	(−2.96)	(−5.40)	(−2.95)	(0.43)	
RW forecasts	−0.01%				0.90
	(−1.14)				
	−0.01%***	−0.24%***	−0.18%***	0.13%	3.10
	(−2.94)	(−6.05)	(−3.12)	(0.43)	
P/E ratio	−0.06%				1.07
	(−0.36)				
	−0.54%***	−0.30%***	−0.18%***	0.27%	3.20
	(−3.42)	(−7.88)	(−3.07)	(0.90)	
P/B ratio	0.13%***				0.55
	(2.93)				
	0.21%***		−0.17%***	−0.01%	2.57
	(4.98)		(−2.94)	(−0.03)	
P/D ratio	−0.06%				1.33
	(−0.66)				
	−0.22%***	−0.16%***	−0.11%**	−0.30%	3.81
	(−2.96)	(−4.48)	(−2.04)	(−0.81)	
Dechow et al. (2004)	0.01%				0.36
	(0.57)				
	−0.01%	−0.23%***	−0.17%***	0.00%	2.71
	(−0.55)	(−5.16)	(−2.97)	(0.01)	
Cash flow duration					
Analyst forecasts	0.32%*				1.76
	(1.76)				
	−0.14%	−0.27%***	−0.20%***	0.05%	3.29
	(−1.10)	(−6.69)	(−3.95)	(0.15)	
AR(1) forecasts	0.38%**				0.96
	(2.52)				
	−0.08%	−0.23%***	−0.18%***	0.06%	2.97
	(−0.65)	(−5.16)	(−3.39)	(0.20)	
RW forecasts	0.30%**				0.88
	(2.56)				
	−0.02%	−0.24%***	−0.18%***	0.04%	2.88
	(−0.19)	(−5.63)	(−3.23)	(0.14)	
Da (2009)	0.01%***				0.89
	(3.61)				
	0.02%	−0.19%***	−0.29%***	−0.53%	4.03
	(7.74)	(−3.53)	(−4.59)	(−1.47)	

Annotation to table 6

The table compares the equity and cash flow duration measures based on analyst forecasts with alternative equity and cash flow duration measures. Alternative equity duration measures include duration estimates using earnings forecasts based on a random walk and a AR(1) process following Fairfield et al. (2009), and various price-to-fundamental ratios. Similarly, alternative cash flow duration estimates are based on random walk and AR(1) earnings forecasts. In addition, the table includes the implied equity duration estimates following Dechow et al. (2004) and the ex-post cash flow duration estimates following Da (2009).
Panel A summarizes the mean, standard deviation, and quartiles of firms' various duration estimates. Panel B presents the correlation statistics, calculated as the mean of the monthly cross-sectional correlations. We use the natural logarithm of firm size and B/M ratio to reduce their skewness. Panel C shows the average monthly return of a portfolio that is long in long-duration stocks and short in short-duration stocks. Panel D presents the results of Fama and MacBeth (1973) regressions of monthly stock returns on the equity duration measures and the Carhart firm risk characteristics, similar to table 4. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. For more details on the variable construction, see table 1.

Table 7: Simulation study

Panel A: Main simulation parameters

Variable	Value
Implied short-term equity yield	8.22%
Implied long-term equity yield	10.45%
Long-term growth in residual income	2.6%
Payout ratio	50%

Panel B: Means

	Simulated data	Actual data
Equity duration	19.17	19.11
Cash flow duration	15.59	16.81
Expected return	9.83%	9.83%
Expected growth	17.83%	17.72%
B/M ratio	0.33	0.33

Panel C: Standard deviation

	Simulated data	Actual data
Equity duration	9.38	7.57
Cash flow duration	2.71	2.06
Expected return	3.19%	3.20%
Expected growth	40.21%	44.20%
B/M ratio	0.66	0.66

Panel D: Correlation statistics

	Simulated data	Actual data
EQ duration/CF duration	0.102	-0.092
EQ duration/expected return	-0.746	-0.778
EQ duration/expected growth	0.116	-0.088
EQ duration/BM-ratio	-0.006	-0.087
CF duration/expected return	0.224	0.224
CF duration/expected growth	0.750	0.088
CF duration/BM-ratio	-0.474	-0.158

The table presents the results of the simulation study, which is based on an artificial cross-section of 1,000 firms. The simulation parameters governing discount rates, earnings and earnings growth rates are chosen such that the mean estimates obtained from the simulated data match those of the actual data. Furthermore, the slope of the equity yield curve is chosen such that the correlation between expected returns and cash flow duration matches the correlation observed in the data.
Panel A reports the main parameters and assumptions of the simulation study. Panel B and C report the empirical distribution of the estimates obtained from the simulated and the actual data. Panel D compares the correlation statistics between the key variables obtained from both data sets.

Table 8: Robustness: biases in analyst forecasts

Panel A: Descriptive statistics

	Mean	Std. dev.	25% centile	50% centile	75% centile
Equity duration					
Lowest forecasts	20.27	8.82	15.55	18.53	22.18
Highest forecasts	18.09	6.83	14.22	16.98	20.11
EF-adjusted forecasts	19.17	7.66	14.93	17.82	21.19
FE-adjusted forecasts	19.11	7.63	14.91	17.75	21.08
Cash flow duration					
Lowest forecasts	16.82	2.07	15.23	16.46	18.37
Highest forecasts	16.80	2.06	15.21	16.42	18.33
EF-adjusted forecasts	16.81	2.06	15.22	16.44	18.35
FE-adjusted forecasts	16.81	2.06	15.22	16.44	18.35

Panel B: Sorts

	Monthly long-short portfolio returns	
	equal-weight portfolios	value-weight portfolios
Equity duration		
Lowest forecasts	$-0.54\%^{**}$	$-0.61\%^{**}$
	(-2.41)	(-2.29)
Highest forecasts	$-0.74\%^{***}$	$-0.75\%^{***}$
	(-3.10)	(-2.57)
EF-adjusted forecasts	$-0.58\%^{**}$	$-0.67\%^{**}$
	(-2.53)	(-2.38)
FE-adjusted forecasts	$-0.64\%^{***}$	$-0.68\%^{**}$
	(-2.76)	(-2.37)
Cash flow duration		
Lowest forecasts	0.40%	0.20%
	(1.19)	(0.47)
Highest forecasts	0.42%	0.24%
	(1.24)	(0.57)
EF-adjusted forecasts	0.38%	0.11%
	(1.11)	(0.26)
FE-adjusted forecasts	0.40%	0.16%
	(1.19)	(0.38)

Table 8, continued

Panel C: The cross-section of monthly stock returns

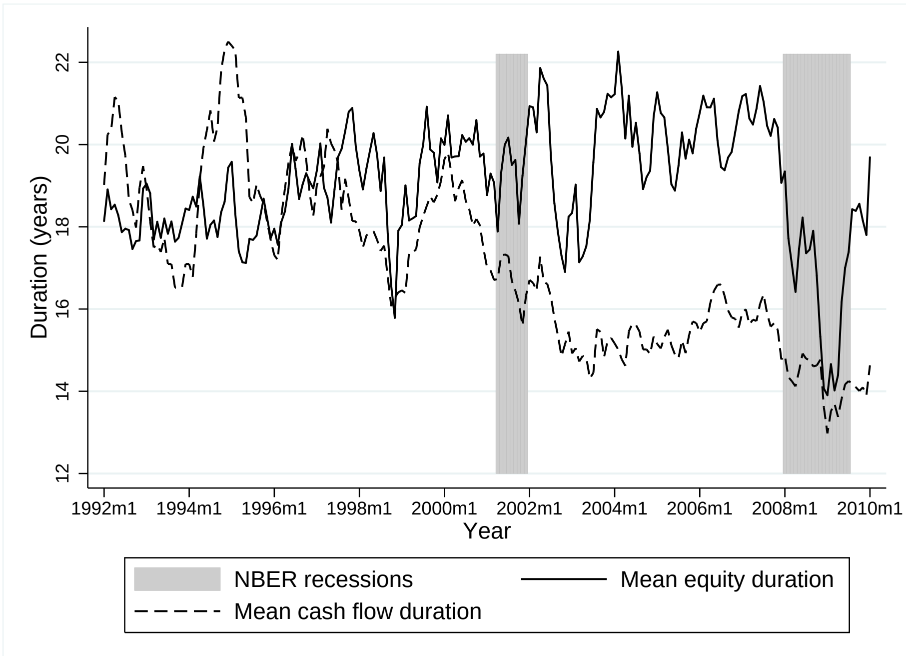
	Duration measure	B/M ratio	Size	Price momentum	adj. R^2
Equity duration					
Lowest forecasts	−0.00%*				0.50
	(−1.74)				
	−0.01%*	−0.19%***	−0.17%***	−0.02%	2.83
	(−1.69)	(−4.66)	(−2.81)	(−0.05)	
Highest forecasts	−0.03%**				0.56
	(−2.51)				
	−0.03%***	−0.21%***	−0.18%***	0.09%	2.79
	(−3.12)	(−5.22)	(−2.98)	(0.31)	
EF-adjusted forecasts	−0.02%**				0.51
	(−2.04)				
	−0.02%**	−0.20%***	−0.18%***	0.06%	2.76
	(−2.20)	(−4.99)	(−2.95)	(0.21)	
FE-adjusted forecasts	−0.02%**				0.57
	(−2.51)				
	−0.02%***	−0.20%***	−0.17%***	0.08%	2.84
	(−2.75)	(−4.88)	(−2.87)	(0.26)	
Cash flow duration					
Lowest forecasts	0.22%				1.64
	(1.19)				
	−0.26%**	−0.25%***	−0.21%***	0.01%	3.02
	(−2.26)	(−6.53)	(−4.16)	(0.02)	
Highest forecasts	0.21%				1.57
	(1.16)				
	−0.25%**	−0.26%***	−0.22%***	0.04%	3.01
	(−2.16)	(−6.86)	(−4.35)	(0.14)	
EF-adjusted forecasts	0.22%				1.61
	(1.19)				
	−0.26%**	−0.26%***	−0.23%***	0.08%	3.00
	(−2.23)	(−6.77)	(−4.34)	(0.19)	
FE-adjusted forecasts	0.23%				1.63
	(1.24)				
	−0.24%**	−0.25%***	−0.22%***	0.04%	3.04
	(−2.08)	(−6.52)	(−4.23)	(0.14)	

Annotation to table 8

The table presents the results when using different analyst forecasts measures that aim to correct for potential forecast biases. The duration estimates based on the lowest forecasts are calculated using the lowest analyst forecast, rather than the consensus forecast. Similarly, the estimates based on the highest forecasts are calculated using the highest analyst forecast. The duration estimates based on the EF-adjusted forecasts estimates are calculated using the external-financing-adjusted forecasts EPS_i^{EF}; the duration estimates based on the FE-adjusted forecasts estimates are calculated using the forecast-error-adjusted forecasts EPS_i^{FE}. For more details on the construction of EPS_i^{EF} and EPS_i^{FE}, see section 7.3.
Panel A summarizes the mean, standard deviation and quartiles of the duration estimates. Panel B shows the average monthly return of a portfolio that is long in long-duration stocks and short in short-duration stocks. Panel B shows the average monthly return of a portfolio that is long in long-duration stocks and short in short-duration stocks. Panel C presents the results of Fama and MacBeth (1973) regressions of monthly stock returns on the equity duration measures and the Carhart firm risk characteristics, similar to table 4. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

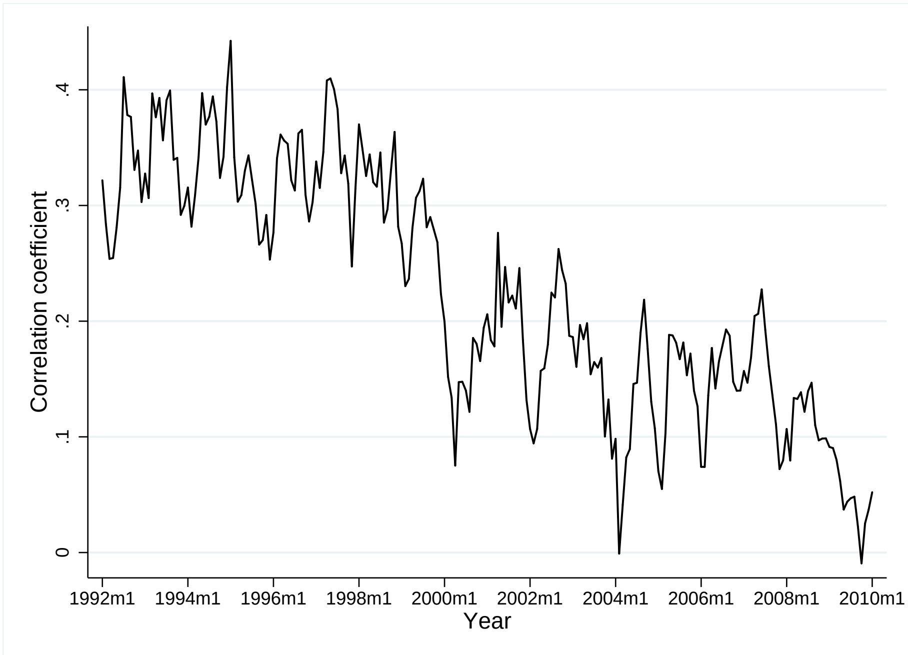
FIGURES

Figure 1: Aggregate U.S. equity and cash flow duration (1992-2010)



The graph plots the monthly mean (equal-weight) equity and cash flow duration in the United States from 1992 to 2010. The shaded areas indicate NBER recessions.

Figure 2: Slope of the U.S. equity yield curve (1992-2010)



The graph plots the monthly correlation between the firms' expected rate of return and their cash flow duration in the United States from 1992 to 2010.